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Award Number: DAMD17-00-1-0533

TITLE: Assessment and Treatment of Shoulder Dysfunction in Post-Polio and Elderly Populations

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REPORT DATE: July 2001

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	July 2001	Annual (1 Jul 00 - 30 Jun 01)

4. TITLE AND SUBTITLE
Assessment and Treatment of Shoulder Dysfunction in Post-Polio and Elderly Populations

5. FUNDING NUMBERS
DAMD17-00-1-0533

6. AUTHOR(S)
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Public Release; Distribution Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 Words)***

Shoulder pain is a common problem among polio survivors. This pain is thought to result from repetitive use of the arms to assist with weight-bearing during mobility and transfer activities when there is significant weakness in one or more of the muscles in the lower extremities. The increased stress on the upper extremities results in symptoms of shoulder overuse. In our previous research, we developed a predictive model of shoulder pain that demonstrated a link between lower extremity strength and weight with the presence of shoulder symptoms. This research, however, left several questions unanswered. Further research is needed to determine whether the shoulder model, which is based on a post-polio population, can be generalized to other groups with lower extremity impairment.

The goals of this project are to study the implications of shoulder dysfunction in the lives of polio survivors and elder adults with no history of polio, in terms of effects on functional performance and quality of life, and to determine whether these factors can be significantly improved as the result of a rehabilitation program.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Shoulder dysfunction, muscle weakness, polio survivors, elderly	9
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

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INTRODUCTION

Although many of the symptoms experienced by polio survivors involve the lower extremities, the increased demand placed on the upper extremities for assistance with weight-bearing during mobility and transfer activities often cause pain and dysfunction to occur in the shoulder muscles. Similar problems are experienced in other populations with significant lower extremity weakness, including the elderly. A heightened awareness of the complications associated with the weight-bearing upper extremity along with effective treatment options are necessary to keep people with lower extremity impairments functioning as fully as possible in society for as long as possible. Concerns about these individuals' long-term prognosis and ability to continue to maintain active roles in society have directed our attention to the study of shoulder dysfunction and its effect on functional performance in polio survivors and the elderly. The goal of this research is to study the implications of shoulder dysfunction in terms of functional performance and qualify of life issues and to determine whether these factors can be significantly improved as the result of an exercise rehabilitation program. Data on disability and function will be used to expand a shoulder model developed as the result of a previous study involving a postpolio population, and the model will be replicated and extended to include elder adults with lower extremity impairments.

BODY

STUDY #1: The Effect of Shoulder Dysfunction on Functional Performance and Quality of Life in Post-Polio and Elderly Populations

The goal of this study was to determine the implications of shoulder dysfunction in the lives of polio survivors and the elderly by expanding the method of shoulder assessment utilized in our previous research to include measures of impairment and functional outcome. The following is a summary of the progress made to date towards that goal.

Within the first quarter, all project staff were hired and trained. Data collection protocols were finalized, and data collection forms were developed, modified and tested for appropriateness and usability. Modifications were made to the forms to accommodate testing order and to enhance efficiency during testing. The original protocol called for the use of a palpometer during the palpation tests to allow the clinician to standardize the amount of pressure being applied for each test. During the training period, it became apparent that the palpometer was very difficult to read during testing resulting in very low repeatability. Therefore, the decision was made to rely on manual methods of palpation for shoulder symptom assessment.

Data from six polio survivors were used to calculate inter-rater and test-retest reliability for the two physical therapists involved in strength testing. In addition, a focus group of six polio survivors was organized to review and critique the established protocol. All members of the focus group felt that although the testing procedure would be intense, adequate rest times were incorporated. No changes to the protocol were indicated.

The inclusion and exclusion criteria were operationalized and specific plans for subject recruitment were developed. Due to the diverse subject population, we identified a wide variety of recruitment sources, which included local newspapers, polio network and support groups

newsletters, Premier Years newsletter (distributed to local seniors by the hospital network), a local television station, and the Polio Connection website. Handouts were developed and distributed to various churches, VFWs, and senior centers in the area. A letter summarizing the inclusion and exclusion criteria and study protocol was also sent to local gerontologists and family practice physicians asking for their help in recruiting potential subjects.

The project database that will be used for storing subject information, symptoms and strength results and for identifying people for the treatment study was designed and implemented. Queries have been written to allow for automatic calculation of summary statistics related to lower extremity performance scores, activity level, shoulder pain and disability scores, and physical and mental health scores.

A weekly testing schedule was developed that would make optimal use of the clinician's limited time. In November 2000, we began collecting baseline data in the Research Clinic on strength, range of motion, shoulder pain, shoulder function, lower extremity function, activity level, and general health status in polio survivors and adults over the age of 60 years with no history of polio.

To date, 197 polio survivors have been screened for this study and 86 have been enrolled and tested. In addition, 132 adults over the age of 60 years with no history of polio have been screened and 75 have been enrolled and tested. The following is a summary of the preliminary data analyses that have been initiated so far.

Of the 86 polio survivors who have been tested so far, 53 (62%) reported shoulder pain with daily activity. Similarly, of the 75 older adults with no history of polio who have been tested, 20 (27.8%) had shoulder pain. Approximately 53.3% of the 75 non-polio subjects tested to date have reported some level of mobility impairment. The majority of these individuals reported moderate to severe impairment in one or more of the following activities: walking 0.4 km, climbing one flight of stairs, crouching or kneeling, pushing a large object, or carrying 10 lb.

On average, the polio group is younger than the non-polio group ($p < 0.001$). The mean age for the polio group is 62.3 years (range: 46 – 89), and the mean age for the non-polio group is 72.75 years (range: 60 – 94). Despite the significant age difference, there is no significant difference in activity level as measured by the PACE instrument ($p = 0.652$).

As part of this study, the SF-36 instrument is used to measure health-related quality of life.[1] This instrument consists of eight dimensions: physical function (PF), physical role limitation (RP), bodily pain (BP), general health (GH), vitality/energy (VT), emotional role limitation (RE), social function (SF), and mental health (MH). Each dimension is measured on a scale from 0 to 100 and physical and mental component summary scores are calculated. Preliminary results indicate that there is a significant difference between the polio group and the non-polio group for all the physical function measures (PF, RP, BP, and GH), as well as the social function measure (Figure 1). The polio group scored significantly lower than the non-polio group on all five of these dimensions (all $p \leq 0.002$) indicating that they are more limited in performing physical activities and experience more problems with work or other daily activities as a result of their physical health. These physical problems also interfere with their normal social activities.

Figure 1. Mean SF-36 Scores at Baseline

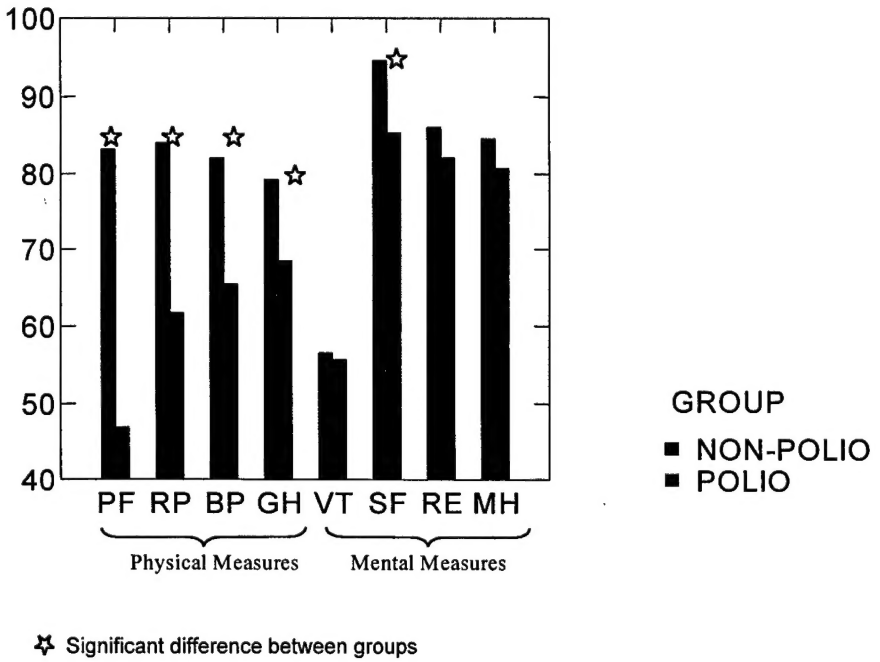
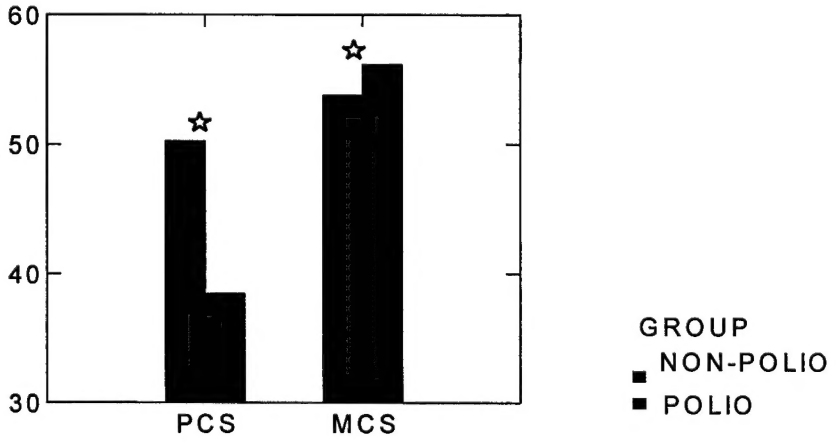


Figure 2. SF-36 Summary Scores at Baseline



PCS – Physical Component Summary Score
MCS – Mental Component Summary Score

When the physical and mental summary scores for the SF-36 were calculated and compared, the results showed a significant difference between groups for both scores (Figure 2). As expected, the non-polio group had a significantly higher physical score than the polio group ($p < 0.001$), which means this group had fewer physical limitations. When the results were compared to those reported for the general U.S. population,[2] the mean physical summary score for the polio group was equivalent to 15th percentile for the general U.S. population, and the mean score for the non-polio group was equivalent to the 37.7th percentile.

Conversely, the polio group's mental summary score was significantly higher ($p = 0.006$) than the score for the non-polio group. When compared to the results published for the general U.S. population,[2] the mean mental summary score for the polio group was equivalent to the 69.8th percentile and the mean score for the non-polio group was equivalent to the 58th percentile.

Data collection is continuing for this study and future analyses will be looking at differences between symptomatic and asymptomatic subjects as well as between polio and non-polio groups.

STUDY #2: The Effectiveness of Exercise on Shoulder Dysfunction in Post-Polio and Elderly Populations

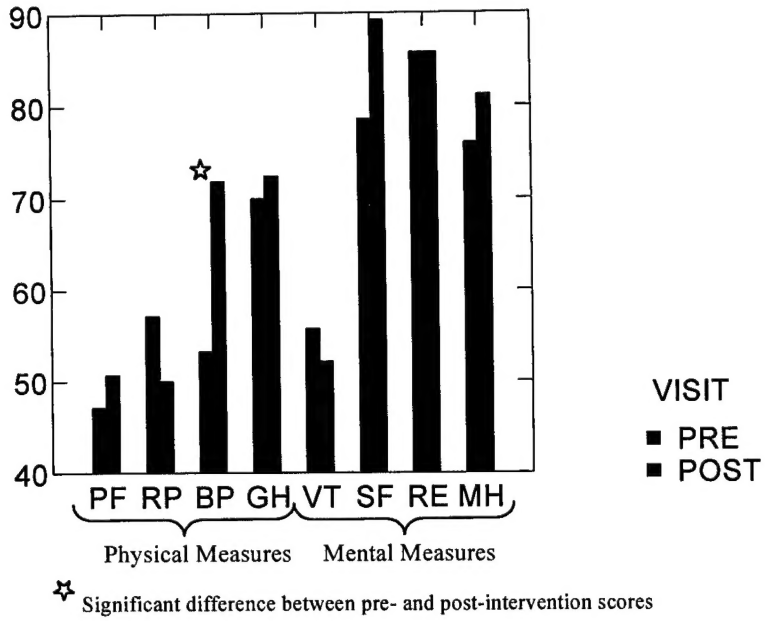
The goal of this study was to determine the impact of exercise on shoulder impairment and function, lower extremity impairment and function, and general health status in post-polio and elderly populations with shoulder dysfunction. The following is a summary of the progress made to date towards that goal.

Two distinct exercise programs have been developed: one that focuses on upper extremity muscle groups and another that focuses on lower extremity muscle groups. The inclusion and exclusion criteria for the treatment study have been operationalized. A testing schedule has been developed involving both physical therapists: one collects strength and symptom data and the other monitors the individually-designed treatment program. The therapist who is involved in assessing the subject strength and pain levels is blinded from the subject's group assignment.

Participants for this study are recruited from the pool of subjects from Study #1. Pre- and post-treatment data on level of impairment, functional ability, and quality of life are collected for each subject. The specific exercises and the lifestyle modification instructions are individually tailored. However, the instructions regarding intensity, duration, and frequency for exercise have been standardized. Subjects are assigned between 4-8 exercises and instructed to exercise up to 60 minutes, three to four days per week. They are also taught to use the Borg scale[3] to monitor their exertion level. Each exercise program is designed to provide a challenge to the functional capacity of the individual without causing excessive fatigue and/or muscle soreness.

To date, 26 subjects have been enrolled in this study. Nine of these subjects have completed their final visit. Preliminary analysis of the SF-36 scores indicated a significant change in the bodily pain dimension ($p = 0.036$) when pre- and post-intervention scores were compared (Figure 3). This change was associated with a reduction in the intensity of bodily pain and the

Figure 3. Comparison of Pre vs. Post Treatment SF-36 Scores
(N = 9)



extent that pain interfered with normal work (Figure 3). There was no significant change in any of the other dimensions.

The results for the SPADI scores also showed a significant decrease in shoulder pain ($p = 0.012$) when the pre- and post-intervention scores were compared. However, there was no significant change in shoulder disability ($p = 0.398$) or in any of the strength variables (all $p > 0.05$) as a result of the intervention.

Data collection is continuing for this study and future analyses will focus on the differences in symptom and functional improvement between treatment groups.

STUDY #3: Analysis of Functional Performance During a Chair Rise Task Before and After Participation in an Exercise Treatment Program

The goal of this study is to assess the effectiveness of the lower extremity exercise training program as a potential method of reducing the burden of impairments and ultimately improving the functional performance of a chair rise task in polio survivors with shoulder dysfunction. The following is a summary of the progress made to date towards this goal.

After some delays and some modifications, the data collection protocol for this study has been finalized. The data that are collected include kinetic, kinematic, and electromyographic data

during performance of a standardized chair rise task. In addition, maximal strength data is collected for shoulder adduction, elbow extension and elbow flexion using a hand-held dynamometer. Electromyographic (EMG) data are also collected during submaximal strength testing at 30% of the maximum strength level and used to normalize the EMG data collected during the chair rise task.

To date, pre-intervention data has been collected on four subjects. The first of these subjects is scheduled for her post-intervention visit in August. All data has been reviewed for integrity and completeness. Data collection has gone according to the desired protocol, with the exception of minor delays during setup and pretest data screening. These problems were due to a combination of intermittent electrode cabling (which has subsequently been replaced) and difficulty in electrode placement due to excessive subject adipose tissue.

Formal data analysis will begin once the first few subjects have completed their exercise program (Study #2) and had their post-treatment evaluation.

KEY RESEARCH ACCOMPLISHMENTS:

- To date, 197 potential polio subjects have been screened and 86 polio survivors have been enrolled and evaluated for Study #1.
- A total of 132 potential non-polio subjects have been screened and 75 of these subjects have been enrolled and evaluated so far for Study #1.
- We have identified 38 Study #1 participants who qualify for the treatment study (Study #2) based on the results of their baseline evaluation. So far, 26 subjects have been enrolled in the treatment study. A total of 4 of these subjects have also participated in the pre-treatment testing for Study #3.

REPORTABLE OUTCOMES: Since data collection only a few months ago, there are no reportable outcomes that have resulted from this research yet.

CONCLUSIONS: This section is not applicable at this time.

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